Understanding and solutions for fixing wet crawlspaces and basements

ACI 2011 San Francisco

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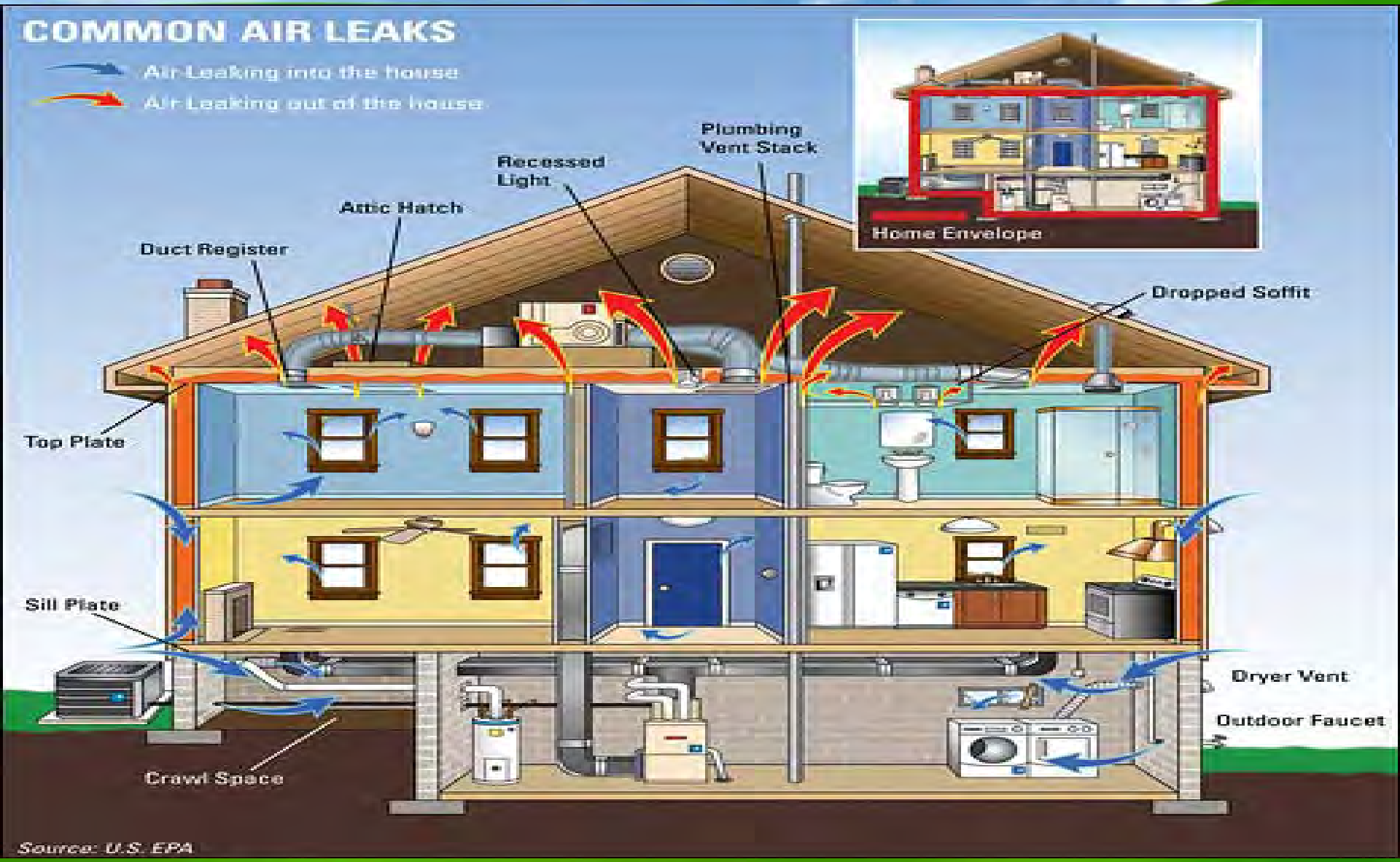
Jason Todd
Home performance training manager
GreenHomes America

Hey that looks familiar…



Some building science history

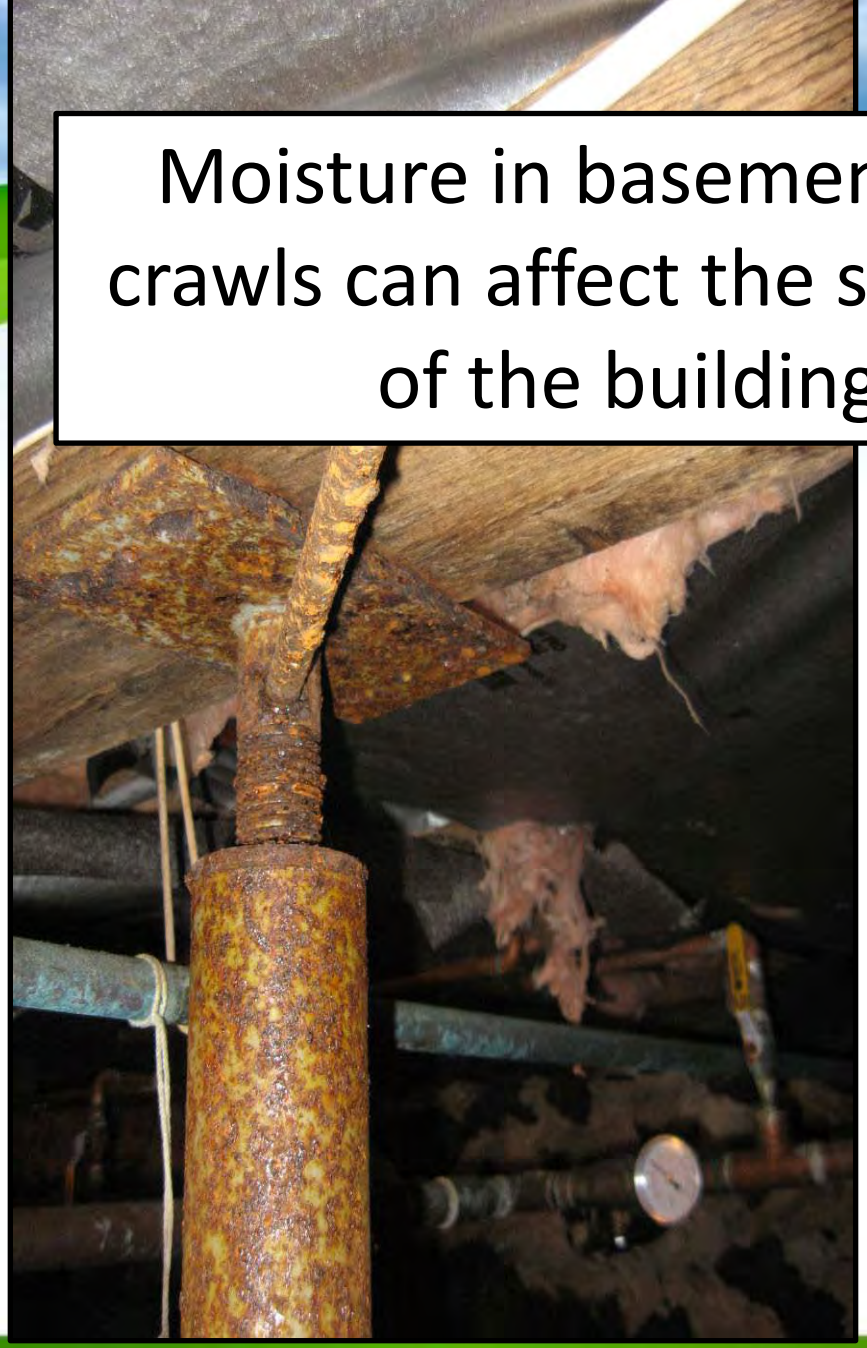
In 1947, Ralph Britton, a government researcher who's work influenced the current attic-ventilation standards, showed that water vapor traveling upward from damp foundations caused most attic moisture problems. He concluded that if attics were isolated from wet foundations, the standard venting ratio could be reduced ten fold.

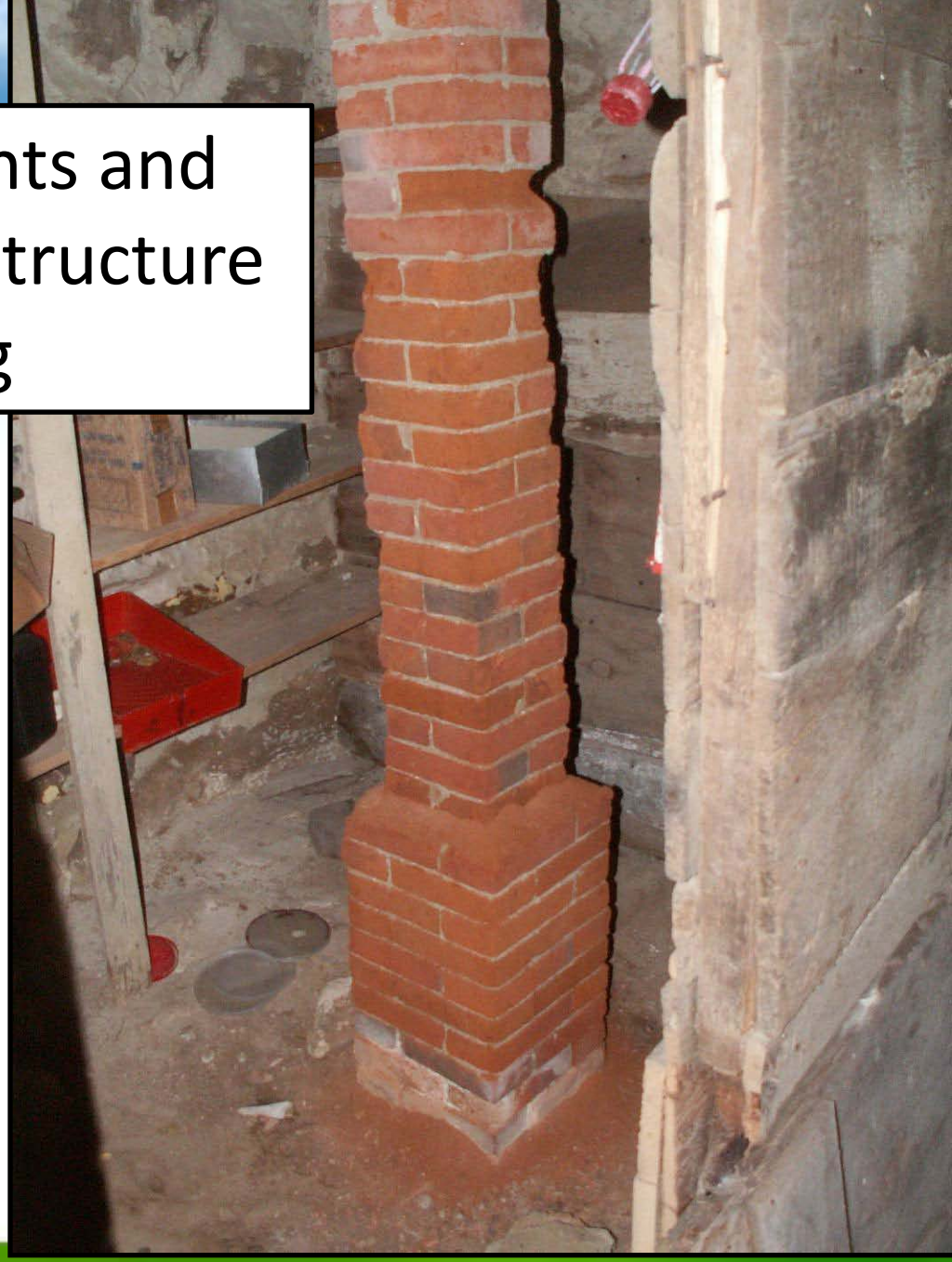
Levittown, New York, 1948

What kind of spaces are we talking about?

Typical costal Maine basement, with oyster shells…

Moisture in basements and crawls can affect the structure of the building



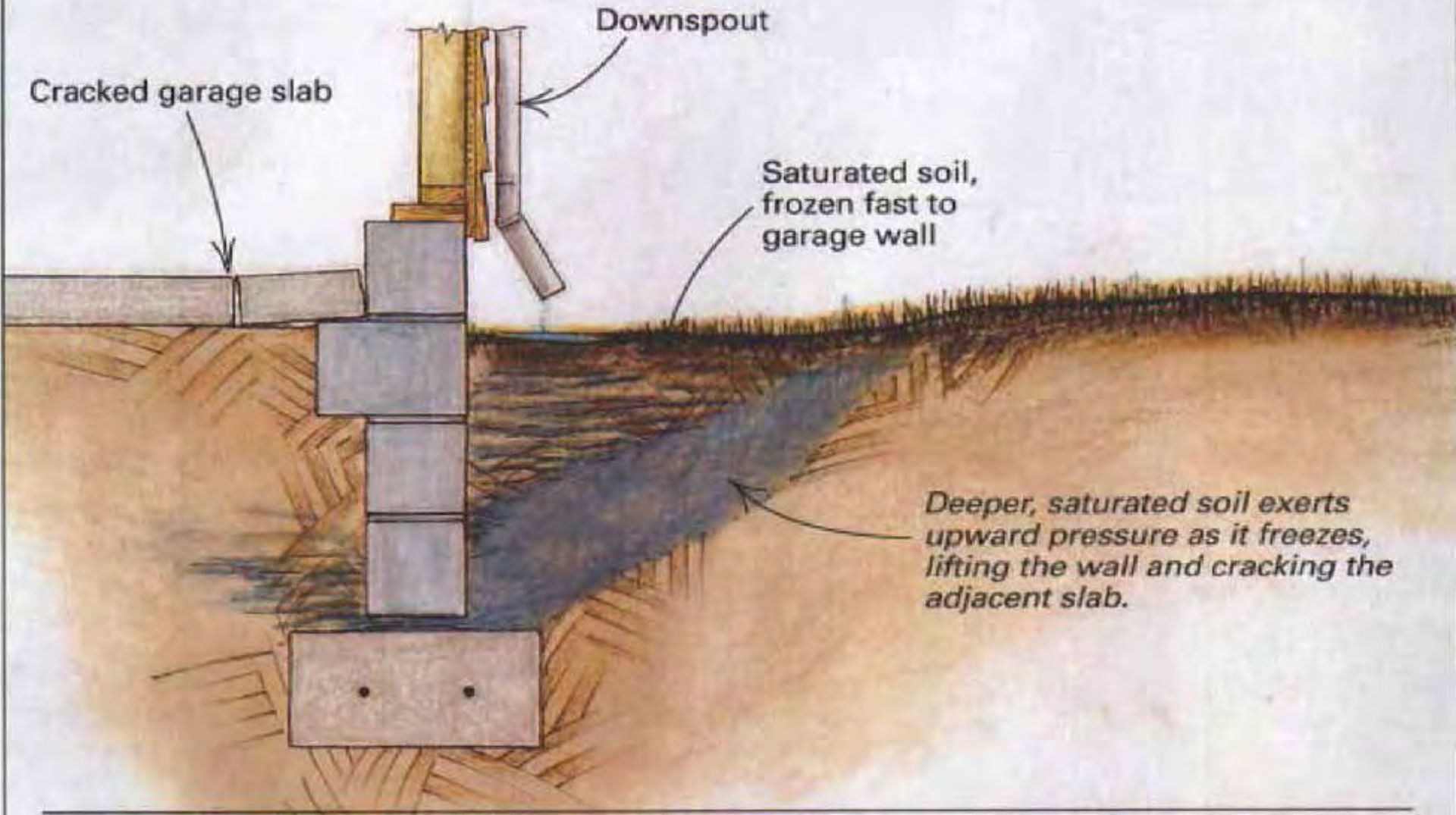


Keep it out: Drainage outside handling bulk moisture

Good drainage around the house is especially important in areas where there are concentrations of water discharge, such as at the discharge of downspouts.

Think of the ground around the house as the roof that keeps the foundation dry

Saturated soil leads to frost heaving. *In a common scenario, water from downspouts has nowhere to go but next to the foundation. This results in damage to a garage slab from soil freezing.*

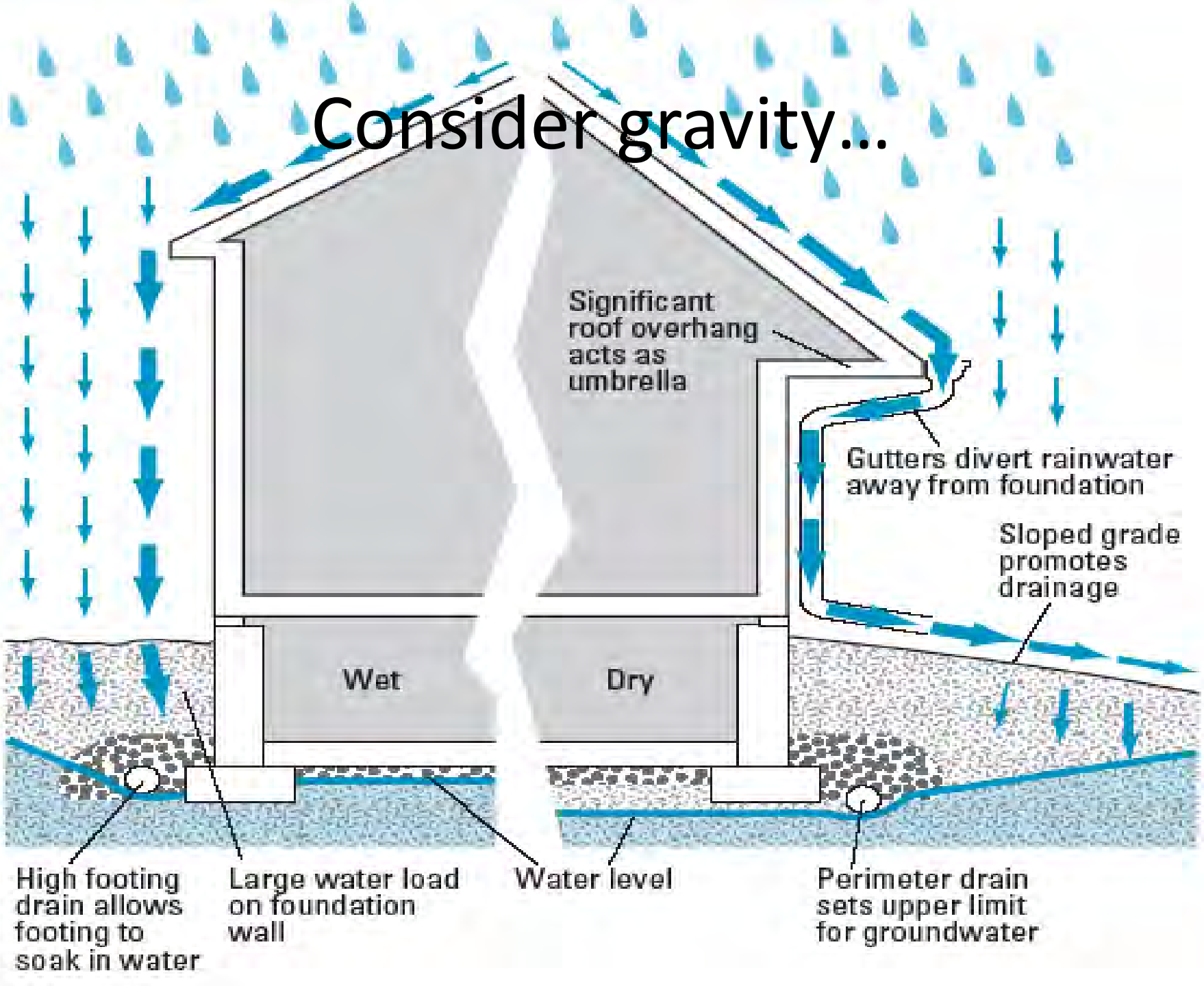


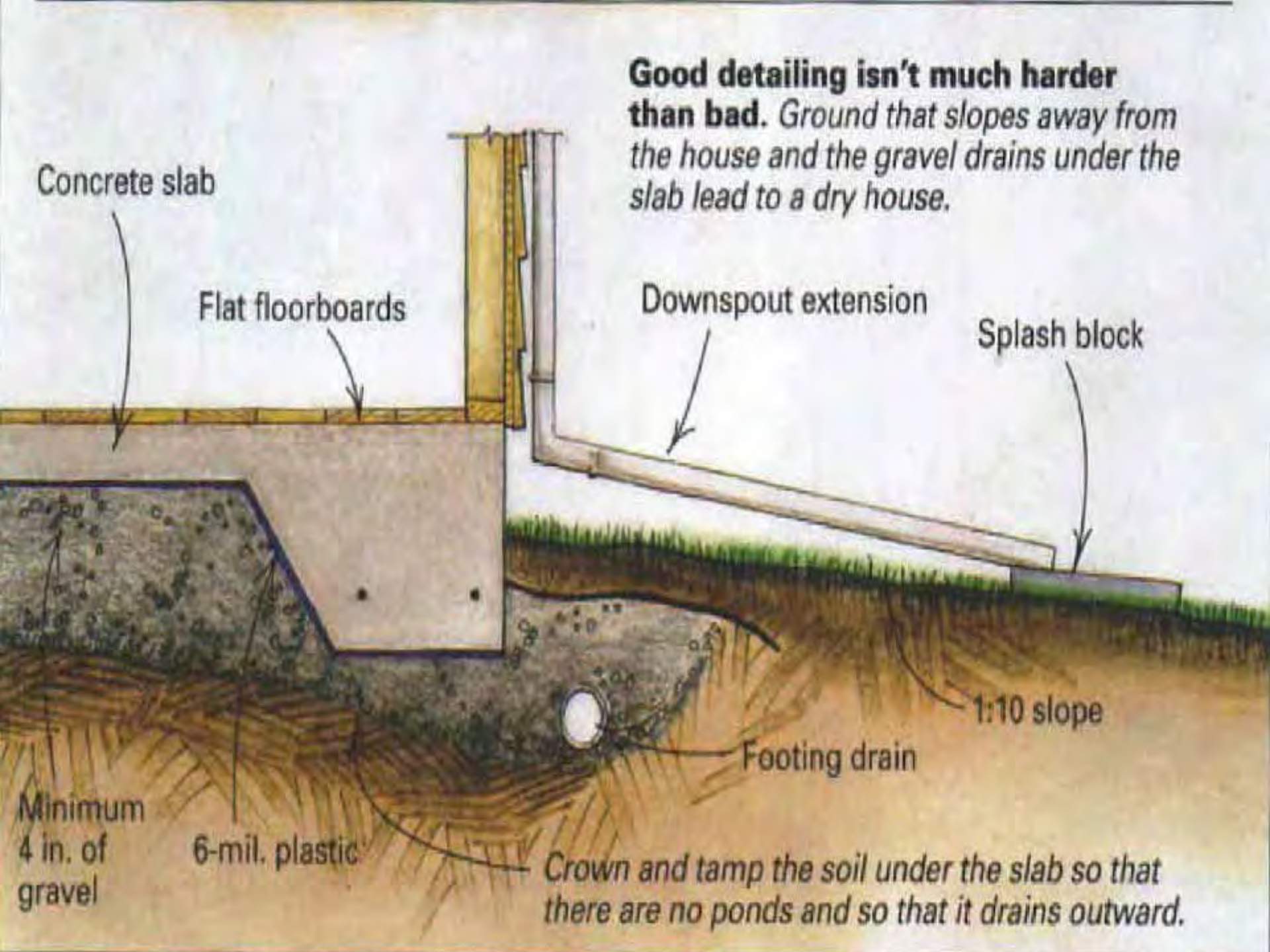
Consider grade

The soil surface should slope outward away from the house (1” per 10’), and there should be no low spots where water can collect near the house…

…and gutters should direct water away from the home.

Consider gravity…





Good detailing isn't much harder than bad. *Ground that slopes away from the house and the gravel drains under the slab lead to a dry house.*

Where should the water go?

AWAY!

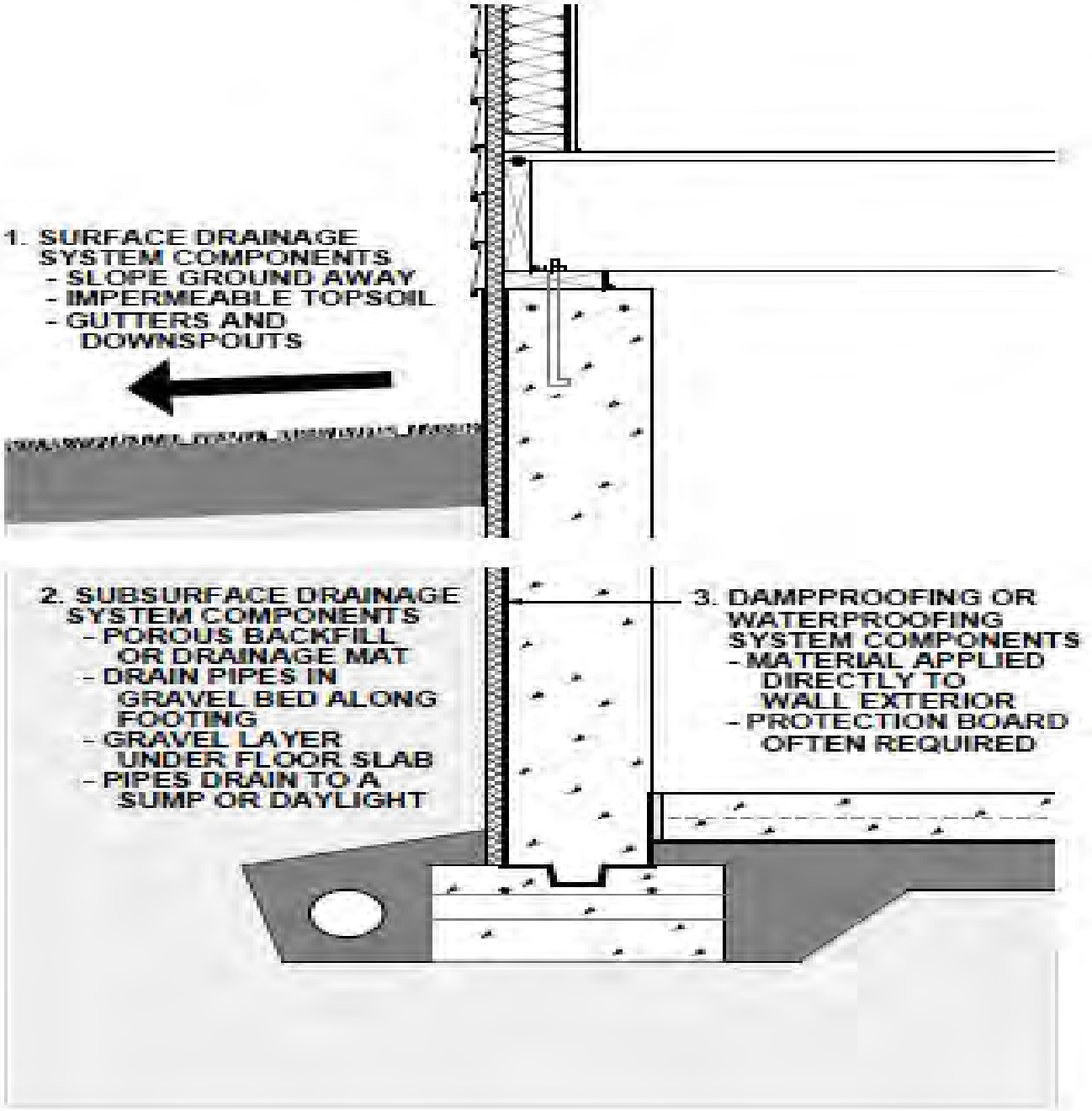
- Municipality may not allow residential runoff to the storm sewer service. Sump pump discharge may also be an issue into the sanitary system.
- IF draining a space to daylight is an opportunity then water may not be an issue. If not to daylight then the 1in. per ft. over 10 ft. is a good target.

Flo well dry well

French Drain

Footing drainage may not be present in homes built more than 40 years ago.

If they are they may not work anymore.



Working on the outside

Exterior work can be disruptive and may require machinery.

But I don't own a back hoe…

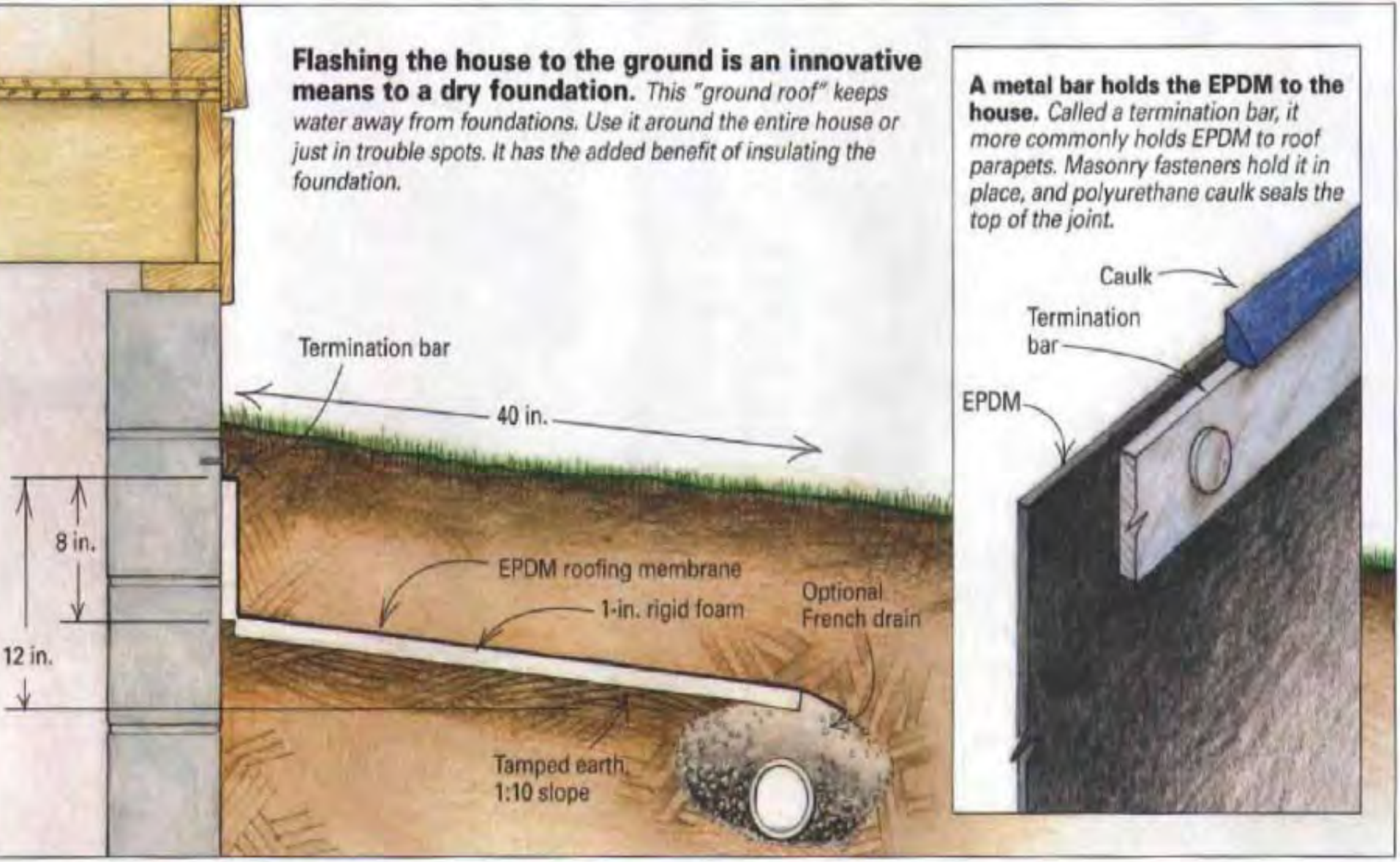
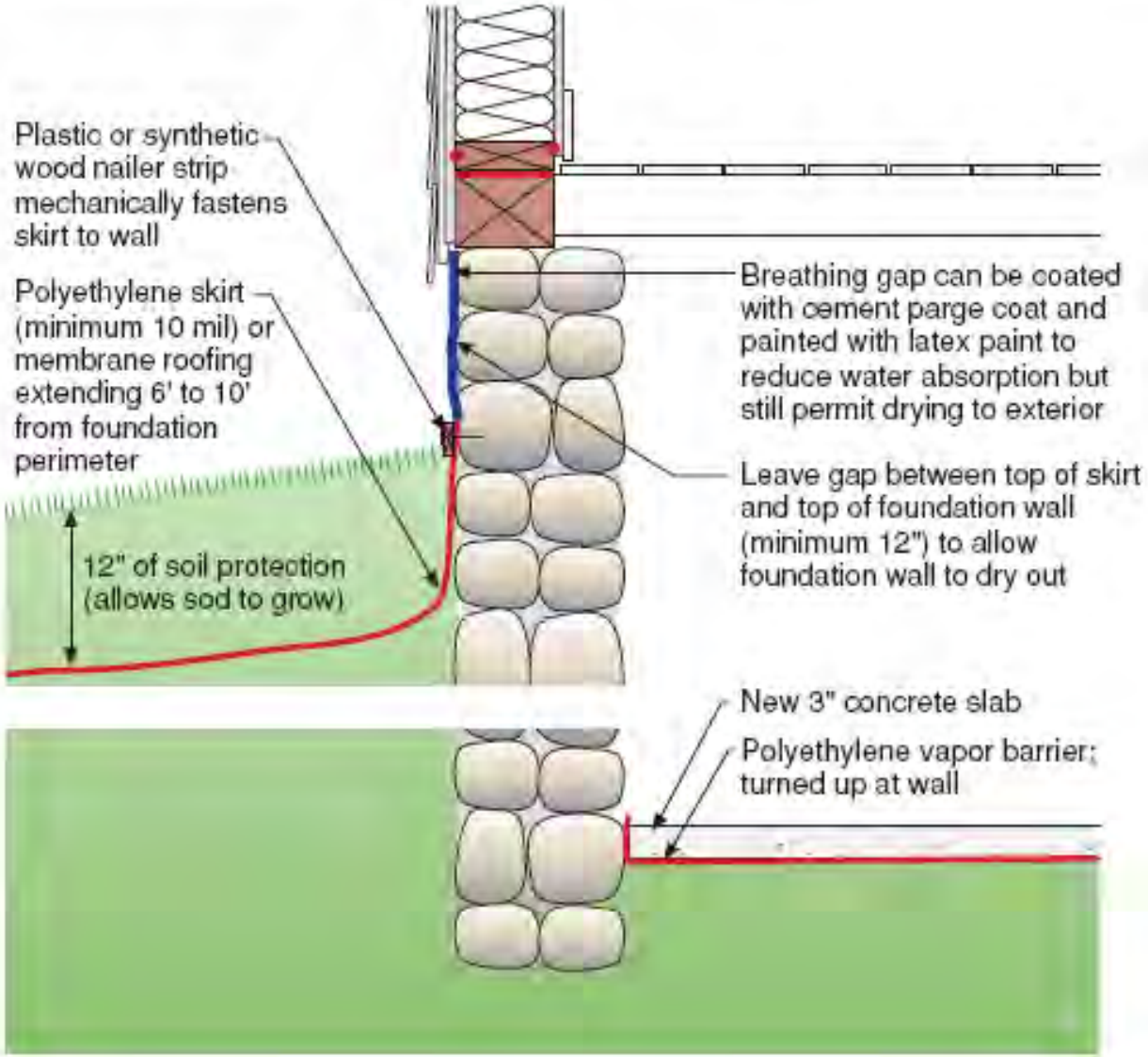


Figure 16

Using an impermeable skirt outside

Using and impermeable skirt outside of the home prevents saturation of ground adjacent to existing foundation.




I don’t like digging that much…

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Working from the inside

- Drainage systems in poured foundations
- Designing and installing the drainage plane
- Walls and floors
- Getting water out: sump pumps

Tunnel-DIGGING as a HOBBY

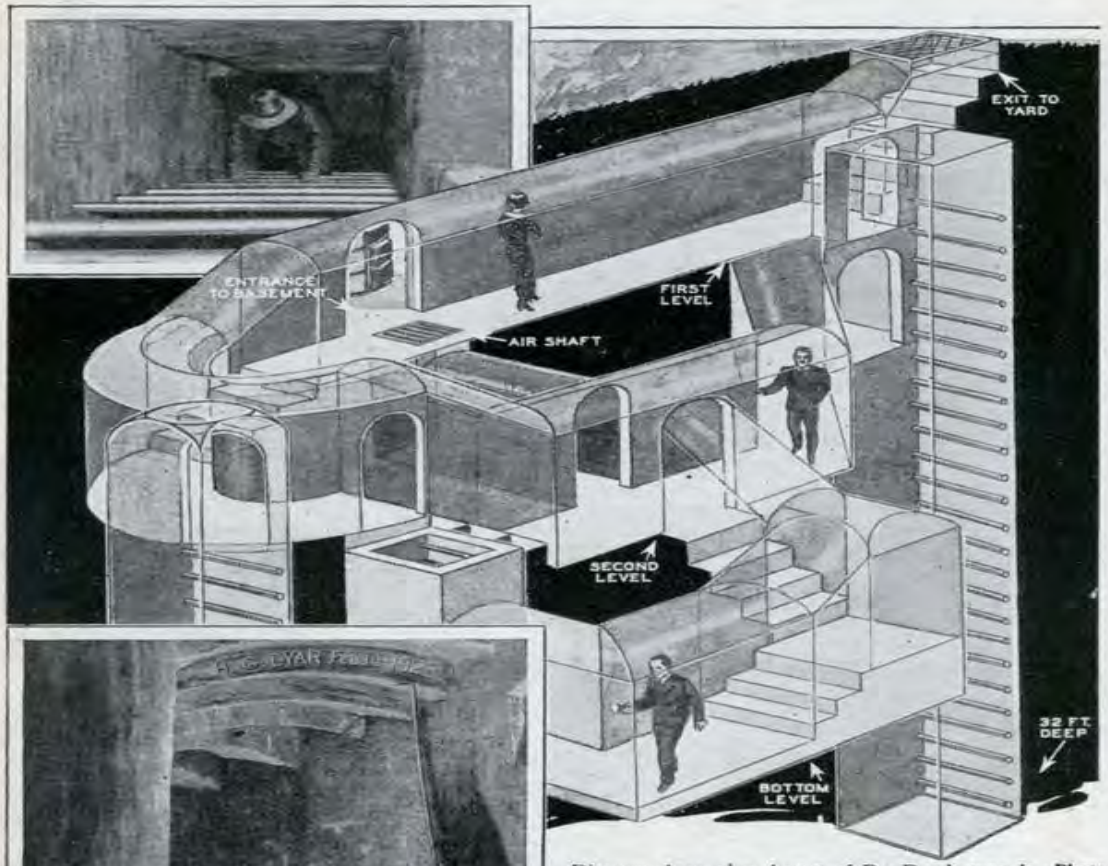
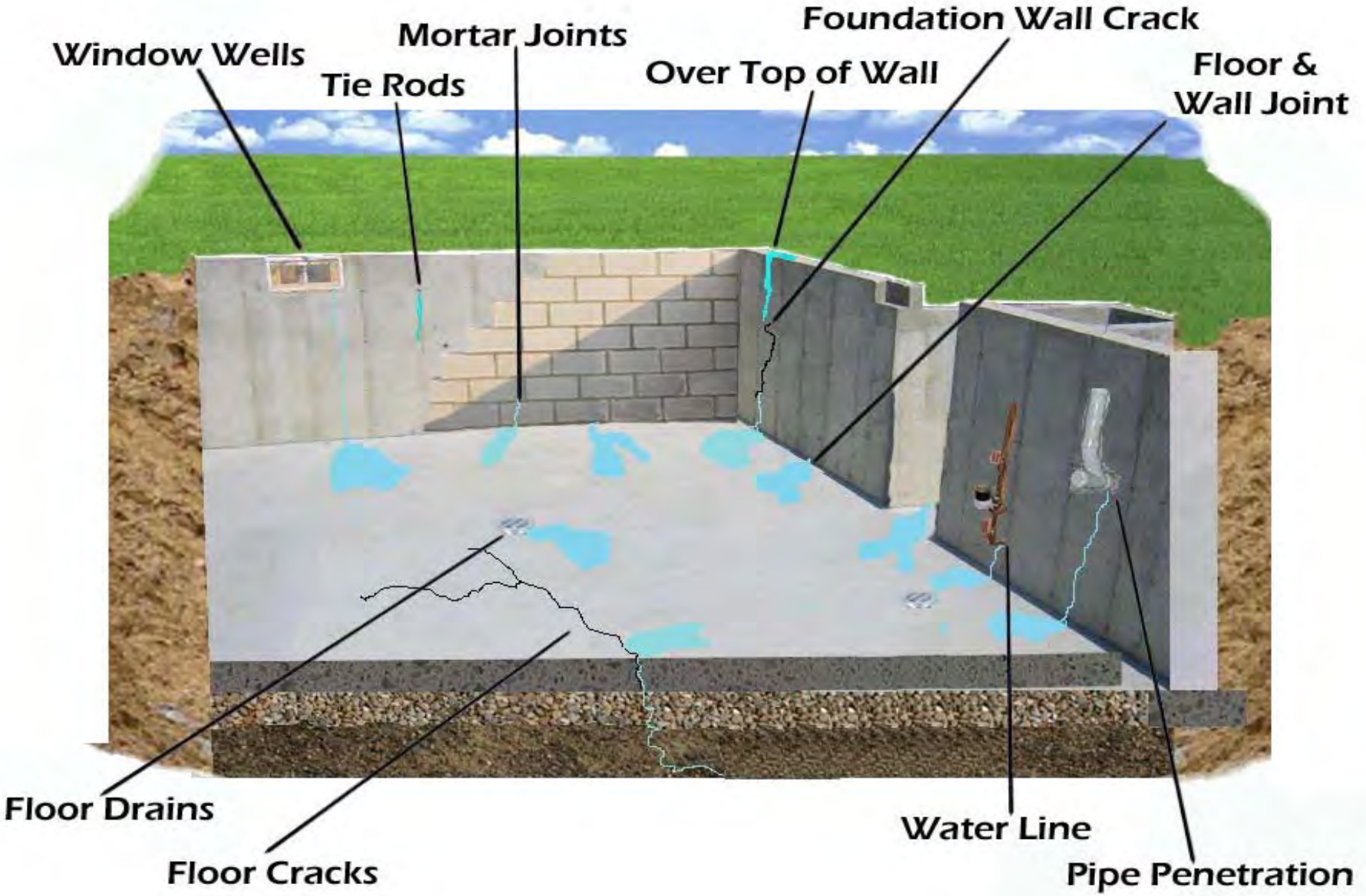


Diagram above gives layout of Dr. Dyar's tunnels. Photo in upper left corner shows explorer descending iron pipe ladder; in picture at left, girl is pointing out the tunnel-builder's signature, imprinted in the concrete with which all the tunnel walls are lined.

ONE of the oddest hobbies in the world is that of Dr. H. G. Dyar, international authority on moths and butterflies of the Smithsonian Institution, who has found health and recreation in digging an amazing series of tunnels beneath his Washington home.

Almost a quarter of a mile of tunnels has been completed, lined with concrete. The deepest passage, illustrated in the accompanying diagram, extends 32 feet down. Every bit of earth was removed unaided by Dr. Dyar, being carried out in pails. He found the tunnel-digging an appealing form of exercise to relieve the intense strain of his work day, which involved much close work with high-power microscopes.

The catacombs are constructed in three levels, with steps and iron pipe ladders leading between different tiers. The idea first came to Dr. Dyar when he sought to make an underground entrance to his furnace cellar.

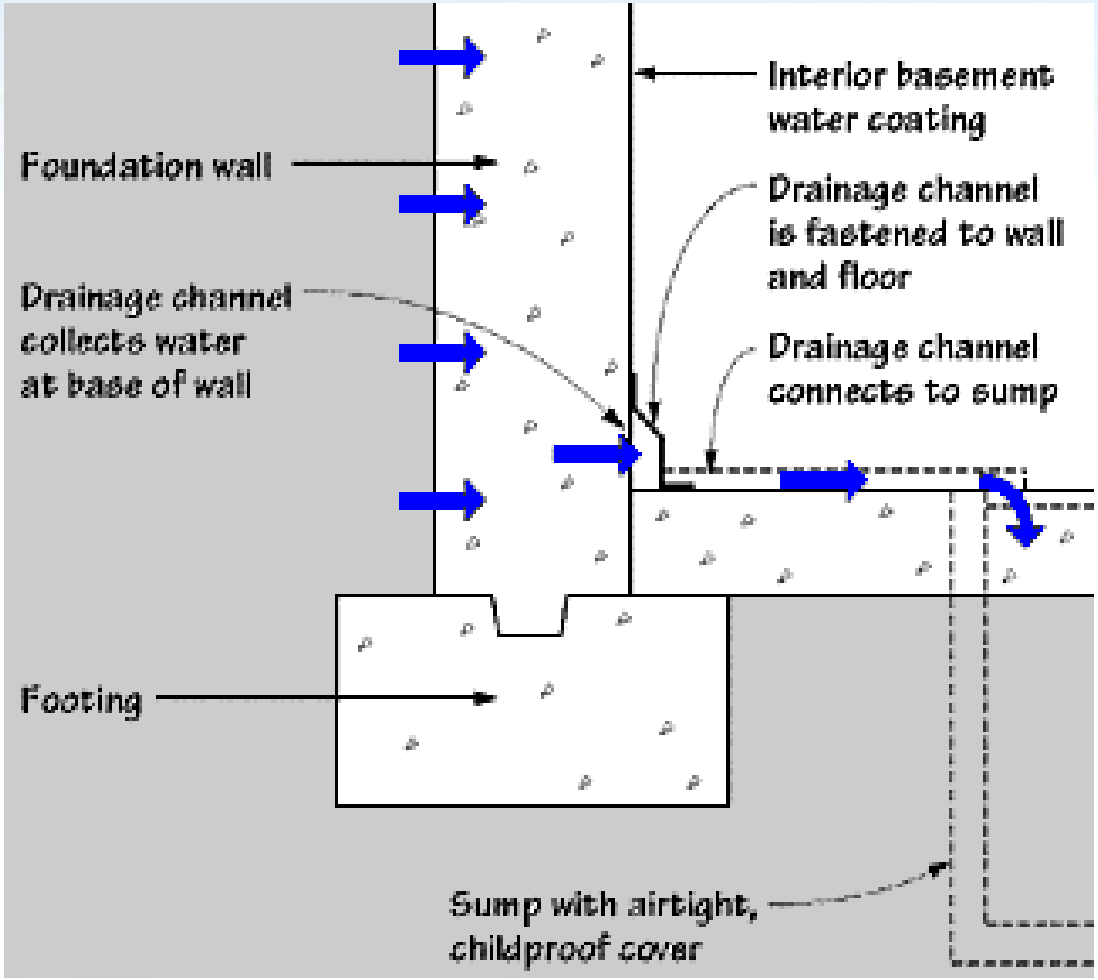

Window Wells
Tie Rods
Mortar Joints
Over Top of Wall
Foundation Wall Crack
Floor &
Wall Joint
Floor Drains
Floor Cracks
Water Line
Pipe Penetration

Its in, you can't keep it out

Paints treat the interior surface. Water can build up in a block core. Vapor diffusion stopper maybe but don't rely on it for bulk moisture issues. It is still getting in. These are applied after larger issues are addressed such as cracks and penetrations.

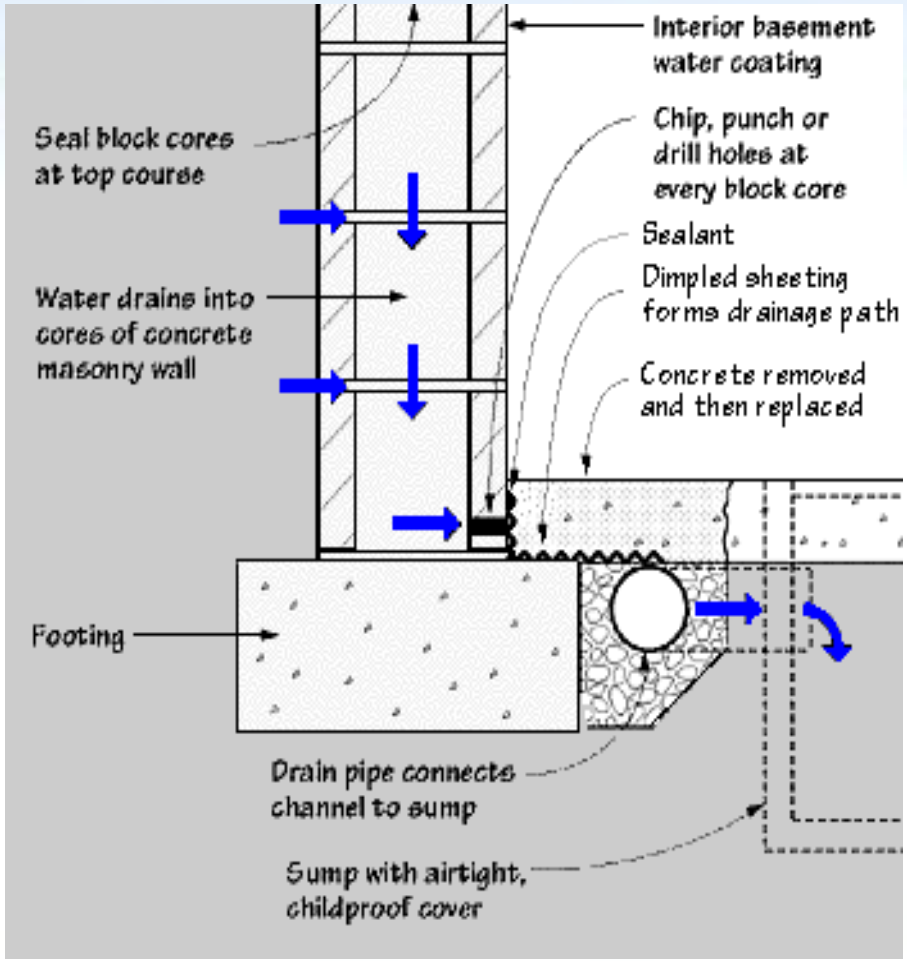
Interior Drainage Channel above the Concrete Slab

- Drainage Channel glued or caulked to floor and wall
- Works with a concrete wall with cracks.
- Humidity, mold, and mildew can still be left in a block wall depending on where holes are.
- Sump needed to lower water sub slab.



Interior Drainage System Beneath the Slab

- Perforated drain pipe installed inside the perimeter of the footing.
- Removing and replacing concrete at the slab edge.
- Dimpled plastic sheeting placed at the base of the wall and beneath the slab edge. Dimpled sheeting is similar to a small egg crate and permits free drainage of the wall into the drain pipe.
- In low permeability soils, this system cannot accept rising groundwater unless there is an aggregate layer under the slab.



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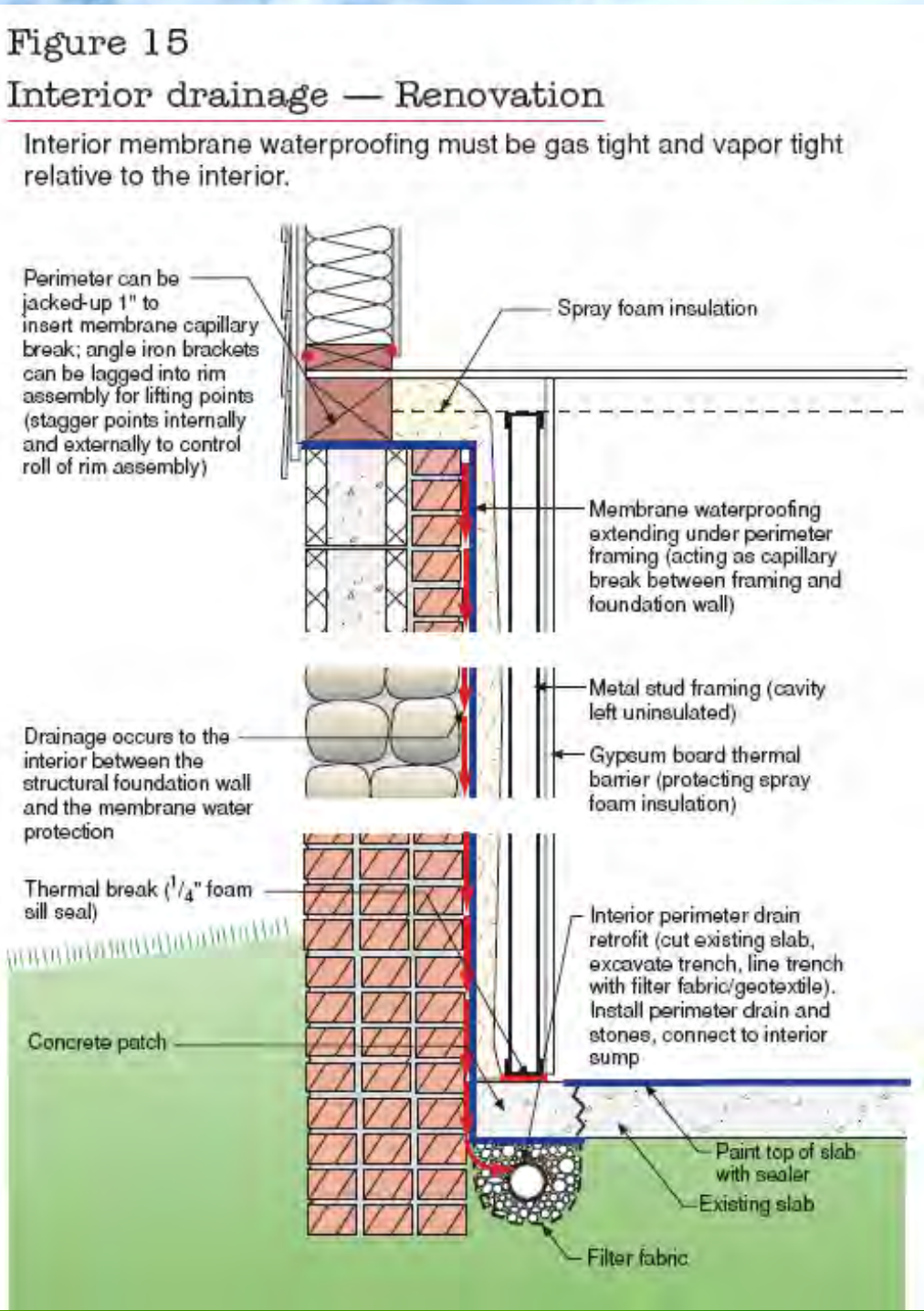
- Addresses wall leaks
- Jacking rim to cap with membrane?
- Foam on the wall over a membrane
- Interior drain retrofit

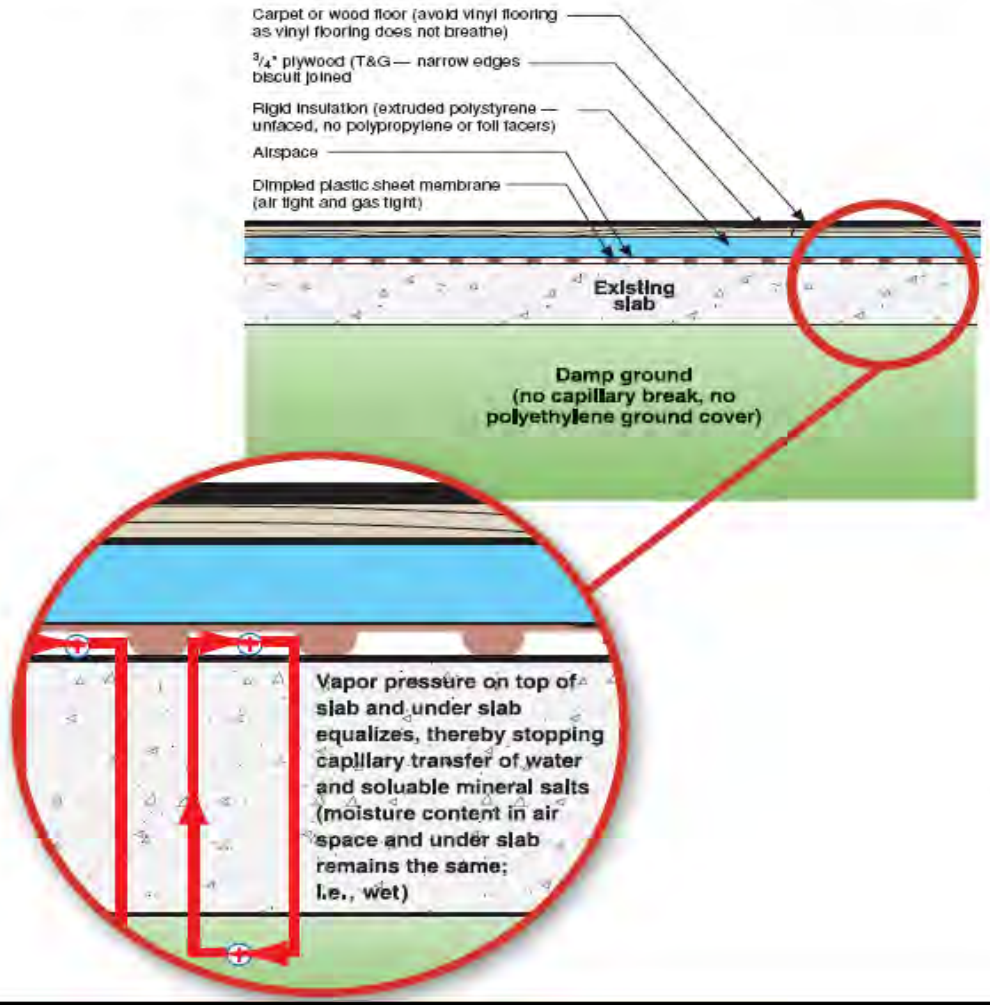


- Nice for slabs not protected with barrier
- Stops capillary transfer of water
- Can be combined with a sump for bulk water

Figure 13

Slab top-side vapor control — Airspace approach

- This approach works both in new construction and in rehabilitation.
- Plywood is glued (T&G edges) to itself and is not mechanically fastened (no screws or nails) through foam and dimpled plastic sheet membrane so that gas barrier/air barrier is not compromised.
- Groundwater leakage can also be handled with this approach by draining the airspace to a sump or floor drain.
- It is important to seal the sheet membrane around the foundation perimeter, thereby isolating the airspace from the interior.



Crawlspace treatments

Works in irregular spaces as well

Most of the time!

Sealed with tape

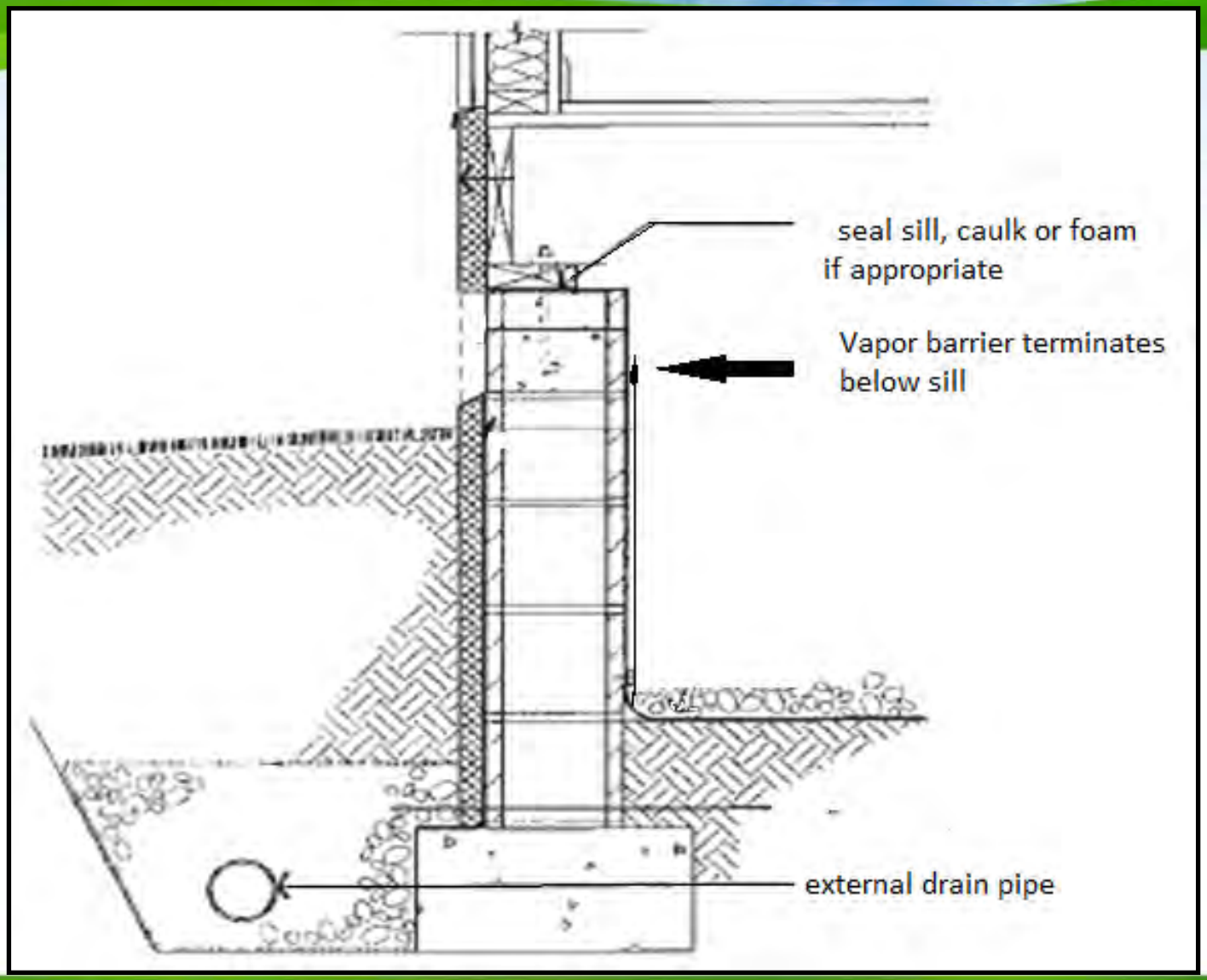
New England “crawlspasement”

Treating the rim joist

Foam is quick and insulates as well; although some regional codes require termite inspection.

Exposed foam may need a fire barrier

Don’t funnel moisture to the sill



Crawlspace Ventilation

and sometimes basements…

IRC R408.1 Ventilation for under-floor space

The under floor space…shall have ventilation openings through foundation walls or exterior walls, minimum 1 sqft for each 150 sqft of space unless… the ground is covered by a class 1 vapor retarder then 1sqft for every 1500sqft of space is allowed. This should provide cross ventilation of the space.

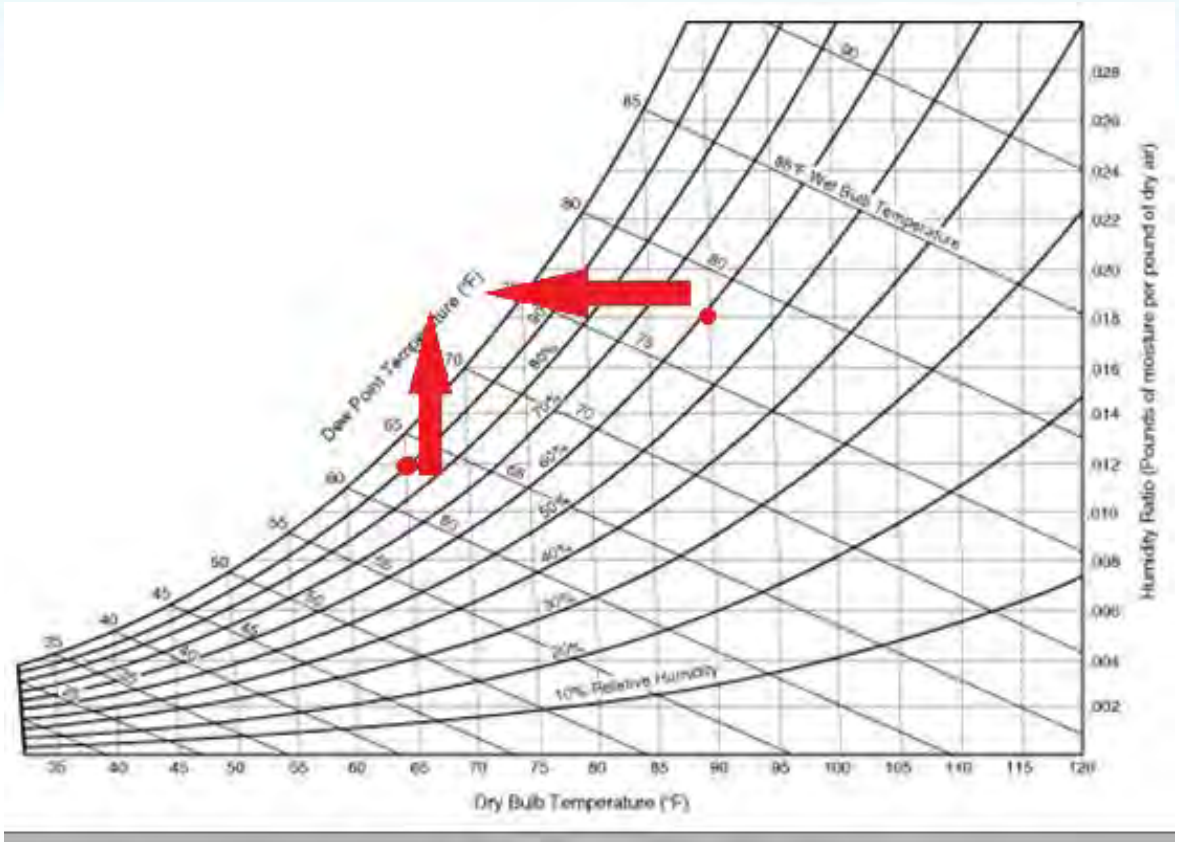
MC reached a maximum in winter and minimum in summer.

- *Mixed-humid and cold climates*
- vents either were lacking or were closed during winter when the coldest members the sill plates, rim joists, and floor joists near the exterior.
- The buildings were not air-conditioned during the summer, and the floor framing therefore was probably warmer than the crawlspace floor (or below-grade portions of the crawlspace walls) for most of the time during summer months.

MC peaked in summer, with a minimum in winter.

- *hot-humid and mixed-humid climates*.
- Various types of crawlspaces (both covered and uncovered, vented and sealed). In many, the living space above air-conditioned.
- Most likely, the major source of crawlspace moisture in these studies was warm, humid outdoor air rather than moisture evaporating from the soil. In summer, the floor members can be cooler than the outdoor air (sometimes cooler than the outdoor dew point temperature), especially when the building is air-conditioned. Lower outdoor temperatures during fall and winter would logically lower the intensity of crawlspace moisture sources.

The problem with trying to dry a crawlspace with vents



When Introducing outside air dew point is a concern

2009 IRC allows a crawl space to be unvented if:

Exposed earth is covered with a continuous Class 1 vapor retarder. Joints of the vapor retarder shall overlap by 6 inches and shall be sealed or taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached and sealed to the stem wall;

And one of the following is provided:

1. Continuously operated mechanical exhaust ventilation
2. Conditioned air supply and return
3. The space is used as a plenum.

Continuously operated mechanical exhaust ventilation?

Pumps

Sump Pumps

- Depending on demand, install one with enough flow or two staggered in height in more extreme conditions
- Battery back up is available too
- In line check valve

Where should the water go?

AWAY!

- Municipality may not allow residential runoff to the storm sewer service. Sump pump discharge may also be an issue into the sanitary system.
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Any Questions?

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